



A flexible mobile-device biosensing instrumentation platform for point-of-care medical diagnostics applications

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Published in:
Proceedings of the 14th Anniversary World Congress on Biosensors

Publication date:
2014

[Link back to DTU Orbit](#)

Citation (APA):
Patou, F., Pfreundt, A., Zulfiqar, A., Dimaki, M., Kjærgaard, C., Madsen, J., & Svendsen, W. E. (2014). A flexible mobile-device biosensing instrumentation platform for point-of-care medical diagnostics applications. In *Proceedings of the 14th Anniversary World Congress on Biosensors*

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A flexible mobile-device biosensing instrumentation platform for point-of-care medical diagnostics applications

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The early diagnosis and monitoring of chronic diseases still constitutes today one of the major healthcare challenges in our society. Advances in nanotechnology and microfluidics have been increasingly empowering researchers and engineers with tools to develop integrated biosensing solutions helping to address this challenge. Specifically, Lab-on-Chip (LoC) devices have a key role to play in the advent of Point-of-Care (PoC) medical applications, driving a shift of the medical diagnostics paradigm and the transition from a centralized, technical, high-throughput biological sample analysis process to a diagnostician and patient-oriented field decision-making support system.

The success of such systems requires the development of highly sensitive and specific biosensors to reliably detect small amounts of relevant biological markers. Nevertheless, the socio-technical complexity of the PoC medical diagnostics context necessitates considering broader requirements, notably in terms of usability, flexibility, and integration capabilities. These characteristics call for multi-disciplinary design methodologies inspired from the field of systems engineering and constitute the motivations for this work.

We present a mobile-device based, PoC biosensing instrumentation platform, designed for multiplexed high-impedance sensing and the electrochemical detection of biological species on a LoC. The proposed system is thus designed as a flexible, user-friendly hardware and software platform allowing programmable electrical readout from LoCs potentially comprehending varied transducers addressing different targeted biological markers. A smart-phone/tablet docking-station embeds the hardware interface necessary for the implementation of a smart-phone digital lock-in amplifier. The platform is tested with high-impedimetric measurements from Silicon-nanowire Field Effect Transistors embedded in a LoC. Programmable firmware and flexible hardware will in turn allow for standard voltammetry and electrical impedance spectroscopy to be performed. The design of a mobile app and standard mobile software libraries will ensure system evolvability, enabling application-specific biosensors readouts and adapted user interfacing.